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No excess mortality among working-age Italians during the Omicron wave of Covid-19

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Abstract

Background: *This study provides updated estimates of the excess deaths in Italy with a focus on the working-age population.* **Methods:** *Over-dispersed Poisson regression models, fitted on 2011-2019 mortality data, and including terms for age, calendar year and a smooth function of the week of the year, were used to estimate the expected number of deaths during the Covid-19 pandemic. The excess deaths were then obtained by the difference between observed and expected deaths and reported according to the pandemic periods defined by the predominant circulating variant of SARS-CoV-2.* **Results:** *Around 170,700 excess deaths at all ages were estimated between March 2020 and March 2022 in Italy with most of the excess occurring during the pre-Delta and Delta period, and 2930 excess deaths (+2.5%) during the Omicron wave. The excesses among the working age population were: 10,425 deaths (+11.8%) during the pre-Delta period, 2460 (+9.4%) during the Delta wave, 283 (+2.2%) during the transition period to Delta. Mortality was lower than expected during the Omicron wave (-6.1%).* **Conclusions:** *Over the periods preceding the Omicron wave, Covid-19 caused around 12,800 excess deaths among individuals of working age, accounting for over 10% excess mortality. This excess was no longer observed during the Omicron wave.*

Introduction

Italy was among the European countries with the highest death toll due to Covid-19 [1, 2]. The majority of those deaths occurred among the elderly population, which given the coexistence of several chronic conditions was at high risk of a severe form of the disease [3]. However, some excess, although lower in absolute terms, has also been observed among the population of working age [3].

In this study, we provides updated estimates of the excess mortality during the Covid-19 pandemic in Italy covering the Omicron wave, with a focus on the working-age population.

Methods

The study is based on national daily mortality data from January 1, 2011 to March 31, 2022 and population data for the calendar years 2011-2022 [4, 5]. We estimated the number of excess deaths by the difference between the observed deaths and the number of deaths that would have been expected had the pandemic not occurred. The expected number of deaths were estimated using two over-dispersed Poisson regression models (one for the male population and one for the female population) fitted on daily mortality data of the years preceding the pandemic (2011-2019). The models

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included a linear term for calendar year (to account for temporal trends in mortality), age groups (to capture the demographic changes over the period), a smooth function of week of the year (to capture seasonal variations) as predictors, and the natural logarithm of the population as offset term. A natural spline was used as a smooth function with number of knots chosen on the basis of quasi-Akaike Information Criterion (QAIC). Up to 10 equally spaced knots were tested.

Excess deaths were reported according to four periods denoted by the predominant variants circulating in Italy [6]: pre-Delta (March 2020-June 2021), Delta (July-November 2021), transition to Omicron (December 2021-January 2022) and Omicron (February-March 2022). Excess deaths were reported both in absolute terms (i.e. number of deaths) and relative terms (i.e. percent relative differences).

Excess deaths at working-age and at all ages were provided with the corresponding 95% confidence intervals (CI). We defined the working-age population as individuals aged 25-64 years, to avoid the inclusion of individuals who may still be in education, and those who are retired.

Results

Table 1 reports the excess deaths estimated in the whole population and in the working-age one by pandemic periods.

Over the whole pandemic period we estimated an excess mortality of 170,746 deaths; 80.4% of them occurred during the period preceding the circulation of the Delta variant, when the excess in relative terms reached +15.9%. During the Delta wave the excess declined to 6.8% but increased to 10.6% during the transition period from the Delta to the Omicron variant, when the peak of cases was registered in Italy. During the months of February and March 2022, when Omicron was the predominant variant in Italy, the excess was +2.5%.

Among the working-age population, an excess mortality was observed in the pre-Delta, Delta and Delta-Omicron transition periods, while no excess was estimated during the Omicron wave. Over the

Table 1. Observed, expected deaths and excess total mortality according to the prevalent circulation of the Delta (δ) and Omicron (o) variants of SARS-CoV-2 among the working-age population and the whole Italian population.

Period	Observed deaths	Expected deaths[1]	Absolute Difference (95%CI)	Percentage difference (95%CI)
Working age				
Pre-δ period	99,012	88,587	10,425 (9477 to 11,358)	11.8 (10.7 to 12.8)
δ period	28,511	26,051	2460 (2179 to 2738)	9.4 (8.4 to 10.5)
δ–o transition period	12,957	12,674	283 (142 to 422)	2.2 (1.1 to 3.3)
o period	11,026	11,748	-722 (-850 to -598)	-6.1 (-7.2 to -5.1)
All ages				
Pre-δ period	1,000,940	863,622	137,318 (131,699 to 142,883)	15.9 (15.2 to 16.5)
δ period	271,051	253,753	17,298 (15,613 to 18,967)	6.8 (6.2 to 7.5)
δ–o transition period	137,944	124,744	13,200 (12,308 to 14,084)	10.6 (9.9 to 11.3)
o period	119,355	116,425	2930 (2144 to 3706)	2.5 (1.8 to 3.2)

CI: Confidence Interval.

[1] Estimated from 2011-2019 mortality and population data, separately by sex, through two over-dispersed Poisson regression models including a linear term for calendar year (to account for the temporal improvement in mortality), age groups as categorical variable (to capture the demographic changes over the period), a smooth function of week of the year with 7 equally spaced knots (to capture seasonal variations), and the natural logarithm of the population as offset. Values were rounded up to the smallest integer.

Periods were defined according to the distribution of SARS-CoV-2 variants in Italy as follows: Pre Delta (March 2020-June 2021), Delta (July-November 2021), Delta-Omicron transition (December 2021-January 2022) and Omicron (February-March 2022).

three periods characterized by higher mortality in this population, we estimated an excess of 13,168 deaths, which accounted for 7.7% of the overall excess estimated at all ages. In relative terms, the excess mortality was +11.8% during the pre-Delta period, +9.4% during the Delta and +2.2% during the Delta-Omicron transition period. A mortality lower than expected was estimated during the Omicron wave (-6.1%).

Discussion

During the Delta wave and the preceding periods, we estimated an important excess mortality among the working-age Italian population. The excess was modest during the Delta-Omicron transition period and was no longer observed during the months characterized by the circulation of the Omicron variant.

These results should be interpreted in the context of the measures adopted during the two years of the Covid-19 pandemic in Italy. Before the circulation of the Delta variant, vaccines had been administered to a limited share of the population, prioritizing older individuals. At that time, the main tools to mitigate Covid-19-associated morbidity and mortality involved a series of measures to reduce the transmission of the infection, including lockdowns, contact tracing, closing of non-essential economic sectors and remote work [7]. This has likely increased the risk of SARS-CoV-2 infection among workers employed in essential sectors, causing disparities across different occupations [8].

It was only in the second half of the 2021 (during the Delta wave) that a considerable share of the Italian population had received Covid-19 vaccination: in July 2021 about 70% of the population age ≥70 years completed the two-dose course of vaccination, while only 23% of the individuals aged 20-59 years had received two doses [9]. In December 2021, when Omicron started to circulate in Italy, the gap between the older population and the working-age population reduced also thanks to the vaccine mandates. As of December 1, 2021, almost 80% of the individuals aged 20-59 years had received two doses, although a lower percentage had been vaccinated with the third dose (6.6% vs 34.5%) [9]. At the beginning of February 2022, 58% of the population aged 20-59 years had received the third dose vs 83% of the older population [9].

During the Omicron wave, mortality among the working-age population was lower than expected. This may be related to the milder disease caused by Omicron particularly in a population with high vaccine uptake [10] and low prevalence of comorbidities, but also to some possible mortality displacement (also known as "harvesting effect") among frail individuals whose deaths may have been brought forward in the periods preceding the Omicron wave.

The excess mortality we estimated among individuals of working age does not fully reflect the excess deaths caused by the Covid-19 among Italian workers, since around one third of Italians aged 25-64 years are unemployed or inactive, including homemakers and those receiving disability pensions. Thus, our study could not quantify the impact of Covid-19 on the working population in Italy as well as the occupational risks related to Covid-19. However, apart from the risks involving health care workers, those related to other occupations are difficult to quantify due to the lack of mortality data disaggregated by occupation categories.

The estimate of the excess death during the pandemic is a difficult task and despite the several attempts that have been made, there is still a high level of uncertainty on its real impact on total mortality [11-13]. These difficulties are mainly related to the estimation of the expected deaths. In our study, we considered the main factors determining the number of expected deaths over the pandemic period, including changes in the age structure of the population, temporal improvement in mortality, and seasonality of mortality data.

Despite these limitations, this work provides an estimate of the excess mortality in a share of the population that given its age and the fact that it represents most of the active part of the population, has several social and economic implications. Moreover, given the increasing concerns on possible sequalae of the infection [14-17], a close monitoring of workers with long Covid or Covid-related sequalae would be useful, and in this regard the occupational physician has a crucial role.

Conclusions

Our results indicate that the Covid-19 pandemic caused an important number of excess deaths among individuals of working age over the periods preceding the Omicron wave in Italy, which was no longer observed during the Omicron wave.

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